



ENERGY STAR[®] Product Specification for Set-top Boxes

Eligibility Criteria Draft 1 Version 5.0

1 Following is the Version 5.0 ENERGY STAR product specification for Set-top Boxes (STBs). A product
2 shall meet all of the identified criteria to earn the ENERGY STAR.

3 **1 DEFINITIONS**

4 A) Set-top Box (STB): A device combining hardware components with software programming designed
5 for the primary purpose of receiving television and related services from terrestrial, cable, satellite,
6 broadband, or local networks and providing video output using at least one direct video connection.

7 B) Displayless Video Gateway (DVG): A device combining hardware components with software
8 programming designed for the primary purpose of receiving television and related services from
9 terrestrial, cable, satellite, broadband, or local networks and providing video without any direct video
10 connection.

11 **Note:** EPA is considering combining the DVG and STB definitions and replacing it with a single STB
12 product category, for simplicity. EPA welcomes feedback on this proposal. Also, EPA welcomes feedback
13 how to continue differentiating between gateways and products covered under the ENERGY STAR
14 specification for Small Network Equipment. In particular, EPA believes there may be uncertainty in
15 classifying MVPD IP gateways. One possible means of clarifying would be to include in this specification
16 a capacity minimum for data (i.e., Mbps/sec). EPA seeks feedback on the appropriate capacity minimum
17 for gateways covered by the ENERGY STAR STB specification. EPA has included the relevant ENERGY
18 STAR SNE definitions for reviewers' consideration along with this proposal regarding capacity.

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20 2) Small Network Equipment (SNE): Network Equipment that is intended to serve users in either
21 small networks or a subset of a large network. SNE includes a) all Network Equipment with
22 integral wireless capability and b) other Network Equipment meeting all of the following
23 criteria:

- 24 a) Designed for stationary operation;
- 25 b) Contains no more than eleven (11) wired Physical Network Ports;
- 26 c) Primary configuration for operation outside of standard equipment racks;
- 27 d) Meets the definition of one or more of the Product Types defined below.

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29 B) Small Network Equipment Types:

30 1) Broadband Access Equipment

31 a) Broadband Modem : A device that transmits and receives digitally-modulated analog
32 signals over a wired or optical network as its primary function. The Broadband Modem
33 category does not include devices with integrated Router, Switch, or Access Point
34 functionality.

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36 b) Integrated Access Device (IAD): A network device with a modem and one or more of the
37 following functions: wired network routing, multi-port Ethernet switching and/or access
38 point functionality.

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40 c) Optical Network Termination Device (ONT): A type of device that converts signals
41 between copper (wired) or wireless connections and an optical fiber connection. ONTs
42 are available in either desktop or building-mounted versions with different connectivity
43 options.

		Primary purpose is receiving television and related services?		
		Yes		No
		Local Video Connection?		
		Yes	No	
Direct Service Provider or Streaming Video Provider Source Input?	Yes	Non- Thin Client STB	Displayless Video Gateway(DVG)	Small Network Equipment (covered in separate ENERGY STAR Specification)
	No	Thin Client/ Remote STB	Excluded from Scope	

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46 C) Product Type (Base Type): The means of access to video content for a STB or DVG.

47 1) Cable: A STB or DVG that can receive television signals from a broadband, hybrid fiber/coaxial,
 48 or community cable distribution system with Conditional Access (CA) or a STB or DVG capable of
 49 receiving cable service after installation of a CableCARD or other type of Conditional Access
 50 system.

51 2) Satellite: A STB or DVG that can receive and decode video content as delivered from a MVPD
 52 satellite network.

53 3) Cable Digital Transport Adapter (DTA): A minimally-configured Cable STB that can receive
 54 television signals from a broadband, hybrid fiber/coaxial, or community cable distribution system.

55 4) Internet Protocol (IP): A STB or DVG that can receive television/video signals encapsulated in IP
 56 packets.

57 i) Over-the-top (OTT) Internet Protocol (IP): An IP STB that cannot receive signals from a
 58 Multichannel Video Programming Distributor (MVPD) as defined in Title 47 U.S. Code § 522.

59 ii) Multichannel Video Programming Distributor (MVPD) Internet Protocol (IP): An IP STB or
 60 DVG that can receive signals from a MVPD.

61 **Note:** EPA has removed the definition for Terrestrial due to lack of market availability of these set-top
 62 boxes.

63 5) Thin-client / Remote: A STB that can receive content over an HNI from another STB or DVG, but
 64 is unable to interface directly to the MVPD network.

65 D) Additional Functionality:

66 1) CableCARD: The capability to decrypt premium audio/video content and services and provide
 67 other network control functions via a plug-in Conditional Access module that complies with the
 68 ANSI/SCTE 28 HOST-POD Interface Standard¹.

69 **Note:** EPA requests information on how quickly the industry expects to transition away from CableCARD.

70 2) Digital Video Recorder (DVR): A feature that records television signals on a hard disk drive (HDD)
 71 or other non-volatile storage device integrated into the STB or DVG for playback at an arbitrary
 72 time. A DVR includes features such as: Play, Record, Pause, Fast Forward (FF), and Fast
 73 Rewind (FR). STBs or DVGs that only support buffering or a Service Provider network-based

¹ <http://www.scte.org/standards/>

- 74 “DVR” service are not considered DVR STBs or DVGs for purposes of this specification. The
75 presence of DVR functionality does not mean the device is defined to be a STB or DVG.
- 76 3) DOCSIS®: The capability to distribute data and audio/video content over cable television
77 infrastructure in accordance with the CableLabs® Data Over Cable Service Interface
78 Specification².
- 79 4) Home Network Interface (HNI): An interface with external devices over a local area network
80 (example: Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wireless-Fidelity or Wi-
81 Fi), Multimedia over Coax Alliance (MoCA), HomePNA alliance (HPNA), IEEE 802.3, HomePlug
82 AV) that is capable of transmitting video content.
- 83 i) Multi-Input Multi-Output (MIMO) Wireless HNI: IEEE 802.11n/ac and related MIMO enabled
84 Wi-Fi functionality that supports more than one spatial stream in both send and receive.
85 When using the notation MIMO AxB: A is considered the number of spatial streams while B is
86 the number of antennas supported. A spatial stream is an independent and separately
87 encoded data signal.
- 88 5) Multi-room: The capability to provide independent live audio/video content to two or more Clients
89 or support pause/time-shifting capability for otherwise standalone IP or Thin-client STBs within a
90 single family living unit. This definition does not include the capability to manage gateway
91 services for multi-subscriber scenarios.

92 **Note:** EPA is proposing to clarify the definition for Multi-room by specifying that support for two or more
93 clients is required, rather than providing a parenthetical note, as in Version 4.1.

- 94 6) Multi-stream: A STB or DVG feature that allows the device to receive multiple independent
95 streams of video content for use with one or more Clients, one or more directly connected Display
96 Devices, or a DVR, picture-in-picture, etc. This definition does not include the capability to
97 manage gateway services for multi-subscriber scenarios.

98 **Note:** EPA clarified that Multi-stream is also used for picture-in-picture capability and welcomes
99 comments on further uses of this functionality.

- 100 7) Ultra HD (4k) Resolution: The capability to transmit or display video signals with a minimum
101 output resolution of 3840x2160 pixels in progressive scan mode at minimum frame rate of 24 fps
102 (abbreviated 2160p24).
- 103 8) High Efficiency Video Processing: Video decoding providing compression efficiency significantly
104 higher than H.264/AVC, for example HEVC (H.265).
- 105 9) Three-dimensional (3D) Capability: The capability to transmit or display video signals with 3D
106 depth information for stereoscopic display.
- 107 10) Access Point: The capability to provide wireless network connectivity to multiple clients. For the
108 purposes of this specification, Access Point functionality includes only IEEE 802.11 (Wi-Fi)
109 connectivity.
- 110 11) Router: The capability to determine the optimal path along which network traffic should be
111 forwarded. Routers forward packets from one network to another based on network layer
112 information. Router functionality includes Access Point functionality.
- 113 12) Telephony: The ability to support analog telephones through one or more RJ11 or RJ14 jacks.

114 **Note:** EPA has clarified that this adder refers to supporting analog telephones, rather than a service,
115 since the majority of all telephone service is digital.

² <http://www.cablelabs.com/specs/>

116 13) Transcoding: Additional capability to translate (e.g., MPEG2 to H.264), transrate (e.g., HD bitrate
117 to Mobile bitrate), transscale (e.g., HD resolution to Mobile resolution), transcript (e.g., CAS to
118 DRM), or perform audio format conversions (e.g., AC-3 to AAC) in real-time.

119 **Note:** Due to the additional system requirements to perform transcoding, EPA is proposing an allowance
120 for this functionality and has therefore provided a definition, harmonized with the Tier 2 Program
121 Requirements of the Industry Voluntary Agreement for Ongoing Improvement to the Energy Efficiency of
122 Set-top Boxes (the VA).

123 E) Auto Power Down (APD): A STB or DVG feature that monitors parameters correlated with the user
124 activity or viewing. If the parameters collectively indicate that no user activity or viewing is occurring,
125 the APD feature enables the STB or DVG to transition to Sleep Mode.

126 F) Principal Function: Functions necessary for selecting (via electronic program guide), receiving,
127 decoding, decompressing, or delivering live or recorded audio/video content to a Display Device,
128 local/remote recording device, or Client. Monitoring for user or network requests is not considered a
129 Principal Function for STBs or DVGs.

130 G) Operational Modes:

131 1) On Mode: The STB or DVG is connected to a power source. At least one Principal Function is
132 activated and all Principal Functions are provisioned for use. The power draw in On Mode may
133 vary based on specific use and configuration.

134 2) Sleep Mode: A range of reduced power states where the STB or DVG is connected to a power
135 source and is not providing any Principal Function. The STB or DVG may transition to On Mode
136 due to user action, internal signal, or external signal. The power drawn in this mode may vary
137 based on specific use or configuration. If any Principal Function is activated while operating in this
138 mode, the STB or DVG is assumed to transition to On Mode. Monitoring for user or network
139 requests is not considered a Principal Function. The STB or DVG shall be able to transition from
140 this mode to On Mode within 30 seconds to be considered in Sleep Mode.

141 3) Deep Sleep State: A power state characterized by reduced power draw that provides additional
142 energy savings.

143 H) Other Definitions

144 1) Display Device (DD): A device (e.g., TV, Computer Monitor, or Portable TV) that receives its
145 content directly from a STB through a video interface (example: High-Definition Multimedia
146 Interface (HDMI), Component Video, Composite Video, or S-Video), not through a HNI, and
147 displays it for viewing.

148 2) Client: A device (e.g., STB, Thin-Client STB, Smart TV, Mobile Phone, Tablet, PC, etc.) that can
149 receive content over a HNI from another STB or DVG.

150 3) External Power Supply (EPS): Also referred to as External Power Adapter. An external power
151 supply circuit that is used to convert household electric current into dc current or lower-voltage ac
152 current to operate a consumer product.

153 4) Standard dc: A method for transmitting dc power defined by a well-known technology standard,
154 enabling plug-and-play interoperability.

155 Note: Common examples are Universal Serial Bus (USB) and Mobile High-definition Link (MHL).
156 Usually Standard dc includes both power and communications over the same cable but that is
157 not required.

158 **Note:** EPA included a new definition for standard dc power, based on the definition in the Version 7.0
159 Displays specification. This definition, proposed changes throughout the specification, and future updates
160 to the Test Method will permit testing and qualification of STBs powered by standard dc.

161 5) Service Provider: A business entity that provides video content, a delivery network, and
162 associated installation or support services to subscribers with whom it has an ongoing contractual
163 relationship. Equivalent with Multichannel Video Program Distributors (MVPDs).

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Note: EPA has clarified that service providers include MVPDs for the purposes of this specification. However, since many of the requirements of the specification also apply to over-the-top IP STBs, EPA has clarified how to apply requirements to OTT IP boxes throughout the specification.

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6) Conditional Access: The encryption, decryption, and authorization techniques employed to protect content from unauthorized viewing. CableCARD and Downloadable Conditional Access System (DCAS) are examples of Conditional Access technology.

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7) Typical Energy Consumption (TEC): A means for evaluating energy efficiency through a calculation of expected energy consumption for a typical household over a one year period, expressed in units of kWh/year.

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8) Unit Under Test (UUT): The STB or DVG being tested.

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l) Product Family: A group of product models that are (1) made by the same manufacturer, (2) subject to the same ENERGY STAR certification criteria, and (3) of a common basic design. Product models within a family differ from each other according to one or more characteristics or features that either (1) have no impact on product performance with regard to ENERGY STAR qualification criteria, or (2) are specified herein as acceptable variations within a product family. For Set-top Boxes, acceptable variations within a product family include:

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1) Aesthetic housing changes that do not affect the thermal characteristics of the device (e.g., color, labeling, or other cosmetic modifications); and

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2) Software configuration.

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2 SCOPE

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2.1 Included Products

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2.1.1 Products that meet the definition of Set-top Box or Displayless Video Gateway, and a Set-top Box Base Type as specified herein are eligible for ENERGY STAR certification, with the exception of products listed in Section 2.2.

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2.2 Excluded Products

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2.2.1 Products that are covered under existing ENERGY STAR product specifications are not eligible for qualification under the STB specification. The list of specifications currently in effect can be found at www.energystar.gov/specifications.

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3 QUALIFICATION CRITERIA

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3.1 Significant Digits and Rounding

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3.1.1 All calculations shall be carried out with directly measured (unrounded) values.

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3.1.2 Unless otherwise specified, compliance with specification limits shall be evaluated using directly measured or calculated values without any benefit from rounding.

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3.1.3 Directly measured or calculated values that are submitted for reporting on the ENERGY STAR website shall be rounded to the nearest significant digit as expressed in the corresponding specification limit.

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3.2 General Qualification Criteria

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3.2.1 External Power Supply (EPS): Single- and Multiple-voltage EPSs shall meet the Level VI or higher performance requirements under the International Efficiency Marking Protocol when tested

203 according to the Uniform Test Method for Measuring the Energy Consumption of External Power
204 Supplies, Appendix Z to 10 CFR Part 430.

205 i. Single- and Multiple-voltage EPSs shall include the Level VI or higher marking.

206 ii. Additional information on the Marking Protocol is available
207 at <http://www.regulations.gov/#!documentDetail;D=EERE-2008-BT-STD-0005-0218>

208 **Note:** EPA has updated the EPS requirements to reflect the new DOE standard going into effect in 2016,
209 which requires a Level VI efficiency for both single- and multiple-voltage EPSs.
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211 3.2.2 Maintenance Activities:

212 i. Products may automatically exit Sleep Mode and/or Deep Sleep State on a regular schedule
213 to download content, scan for program and schedule information, and perform maintenance
214 activities. The total time spent performing maintenance activities shall not exceed an average
215 of two hours in any 24-hour period, exclusive of activities scheduled by the end-user (e.g.,
216 video recording of a regularly scheduled program). Video downloads that are not user-
217 requested (e.g., “speculative recording”, or “push”) shall be counted against the two hour
218 average per day requirement.

219 ii. Products that have exited Sleep Mode or Deep Sleep State and completed maintenance or
220 other user-requested activities shall automatically return to Sleep Mode or Deep Sleep State
221 in less than 15 minutes.

222 iii. Products that provide a speculative recording function shall provide a user-accessible menu
223 option to permit users to disable the functionality. Instructions for disabling speculative
224 recording shall be included in printed and/or electronic product manuals.

225 3.2.3 Auto Power Down (APD): To apply “YES” in Table 1 Operational Mode Durations for Column 1 226 “APD Enabled by Default,” products shall meet the following requirements:

227 i. Products shipped with software from the manufacturer shall ship with APD enabled by
228 default, with APD timing set to engage after a period of less than or equal to 4 hours from last
229 user activity. User activity is defined as any activity in which the user interacted with the UUT.
230 The Emergency Alert System (EAS) system can wake the box and should also be considered
231 user activity for the purposes of this requirement.

232 **Note:** Based on stakeholder questions on the Version 4.1 specification, EPA has added the above
233 clarification on APD timing.

234 ii. Otherwise, the default software download from the Service Provider or manufacturer shall set
235 APD timing to engage after a period of inactivity less than or equal to 4 hours.

236 iii. All energy-related default settings shall persist until an end-user chooses to manually either
237 (1) disable APD, or (2) modify the default settings.

238 3.2.4 Deep Sleep State: To apply “YES” in Table 1 Operational Mode Durations for Column 2 239 “Automatic Deep Sleep,” products shall meet the following requirements:

240 i. A means of activating Deep Sleep shall be present and may include clearly marked button(s)
241 or switch(es) on the remote control that shall begin activation of Deep Sleep within 2 seconds
242 of being pressed and within two button presses. Additionally, Deep Sleep shall be activated
243 via a user-controllable timer or network stimulus. Alternative button configurations or methods
244 of reaching Deep Sleep will be acceptable with written approval from EPA.

245 ii. Products shipped with software from the manufacturer shall ship with Deep Sleep enabled by
246 default.

247 iii. Otherwise, the default software download from the Service Provider or manufacturer shall
248 enable Deep Sleep.

- 249 iv. Deep Sleep functionality shall not prevent a device from performing a user-scheduled DVR
250 recording or other function.
- 251 v. Conversely, a user-scheduled DVR recording or other function shall not prevent a device
252 from entering and remaining in Deep Sleep, except during the time required to perform the
253 DVR recording or other function, and 15 minutes before and after the time required.
- 254 vi. An override function may be provided to allow the end-user to disable Deep Sleep
255 functionality; however, users shall first be offered an explanation of the Deep Sleep feature
256 and provided the opportunity to change the schedule to better suit their needs.
- 257 vii. After the end of Deep/scheduled Sleep time, the STB must resume Sleep Mode functionality
258 including the ability to transition to On Mode in 30 seconds or less.

259 **Note:** EPA seeks feedback on current and forthcoming approaches to deep sleep and ways to simplify
260 and update these requirements to align with the market while continuing to make consumer access to
261 deep sleep activation straightforward.

262 3.3 Typical Energy Consumption (TEC) Requirements

- 263 3.3.1 For STBs, TEC as determined per the test procedure , multiplied by a factor relating to the client-
264 only incentive, shall be less than or equal to the Maximum TEC Specification Requirement
265 (TEC_{MAX}), as illustrated in Equation 1.

266 Equation 1: TEC Requirement for STBs

$$267 (1 - Incentive_{CLIENT_ONLY}) \times TEC \div eff_{ac-dc} \leq TEC_{MAX} = TEC_{BASE} + \sum_1^n TEC_{ADDL_i}$$

268 *Where:*

- 269 ▪ *TEC is the Typical Energy Consumption, as calculated in Equation 3;*
- 270 ▪ *Incentive_{CLIENT_ONLY} is an incentive for Multi-room STBs, as specified in*
271 *Section 3.3.4;*
- 272 ▪ *eff_{ac-dc} is the standard adjustment for ac-dc power conversion losses that*
273 *occur at the device powering the STB, and is 1.0 for Ac-powered STBs and*
274 *0.85 for STBs with Standard dc;*
- 275 ▪ *TEC_{MAX} is the maximum TEC Specification Requirement—the level for*
276 *ENERGY STAR certification;*
- 277 ▪ *TEC_{BASE} is the topmost applicable Base Type TEC Allowance (kWh), as*
278 *specified in Table 2; and*
- 279 ▪ *TEC_{ADDL_i} is each applicable Additional Functionality TEC Allowance (kWh),*
280 *as specified in Table 3, applied once per functionality and subject to the*
281 *requirements in Section 3.3.3, below.*

282 **Note:** EPA has included an ac-dc conversion factor to account for any power conversion losses in the
283 product (such as a television) that is powering a dc-powered STB, and put ac- and dc-powered STBs on
284 an even playing field. EPA welcomes feedback whether the proposed 85% conversion factor is
285 representative of typical conversion losses. EPA is not proposing a similar dc conversion factor for
286 Displayless Video Gateways, as it expects those highly-featured products to be exclusively ac-powered.
287 EPA requests comments on this assumption.

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289 Also, EPA has received feedback that Multi-room STBs already decrease energy consumption when
290 transmitting content to clients rather than the display, such that the incentive may not be necessary. EPA
291 welcomes feedback on this topic.

- 292 3.3.2 For Displayless Video Gateways (DVGs), TEC as determined per the test procedure shall be less
293 than or equal to the Maximum TEC Specification Requirement (TEC_{MAX}), as illustrated in
294 Equation 2.

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Equation 2: TEC Requirement for Displayless Video Gateways (DVGs)

$$TEC \leq TEC_{MAX} = TEC_{BASE} + \sum_1^n TEC_{ADDL_i}$$

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Where:

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▪ *TEC* is the Typical Energy Consumption, as calculated in Equation 3;

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▪ *TEC_{MAX}* is the maximum TEC Specification Requirement—the level for ENERGY STAR qualification;

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▪ *TEC_{BASE}* is the topmost applicable Base Type TEC Allowance (kWh), as specified in Table 2; and

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▪ *TEC_{ADDL_i}* is each applicable Additional Functionality TEC Allowance (kWh), as specified in Table 3, applied once per functionality and subject to the requirements in Section 3.3.3, below.

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Equation 3: TEC Calculation

$$TEC = 0.365 \left[(T_{WATCH_TV} \times P_{WATCH_TV}) + (T_{SLEEP} \times P_{SLEEP}) + (T_{APD} \times P_{APD_ON_to_SLEEP}) + (T_{DEEP_SLEEP} \times P_{SLEEP_SP_2}) \right]$$

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Where:

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▪ *T_{WATCH_TV}* is the time coefficient for On Mode, as determined per Table 1

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▪ *P_{WATCH_TV}* is the measured power in On Mode (W);

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▪ *T_{SLEEP}* is the time coefficient for Sleep Mode, as determined per Table 1;

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▪ *P_{SLEEP}* is the measured power in Sleep Mode (W);

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▪ *T_{APD}* is the time coefficient for APD, as determined per Table 1;

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▪ *P_{APD_ON_to_SLEEP}* is the measured power after an APD timeout (W);

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▪ *T_{DEEP_SLEEP}* is the time operating in Deep Sleep State (maximum of 4h); and

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▪ *P_{SLEEP_SP_2}* is the measured power in the automatically scheduled Deep Sleep State (W).

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Table 1: Operational Mode Durations

APD Enabled by Default	Auto-matic Deep Sleep	<i>T_{WATCH_TV}</i>	<i>T_{SLEEP}</i>	<i>T_{APD}</i>	<i>T_{DEEP_SLEEP}</i>
NO	NO	14	10	0	0
NO	YES	14	10 - <i>T_{DEEP_SLEEP}</i>	0	Deep Sleep as-deployed duration
YES	NO	$7 - \frac{4 - T_{APD_ON_to_SLEEP}}{2}$	10	$7 + \frac{4 - T_{APD_ON_to_SLEEP}}{2}$	0
YES	YES	$7 - \frac{4 - T_{APD_ON_to_SLEEP}}{2}$	10 - <i>T_{DEEP_SLEEP}</i>	$7 + \frac{4 - T_{APD_ON_to_SLEEP}}{2}$	Deep Sleep as-deployed duration

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Table 2: Base Type TEC Allowance (TEC_{BASE_MAX})

Base Type (Use Topmost if Multiple Apply)	Allowance (kWh/year)
1. Cable DTA	40
2. Cable	40
3. Satellite	40
4. Multichannel Video Programming Distributor (MVPD) Internet Protocol (IP)	40
5. Thin-client / Remote	7
6. Terrestrial	
7. Over the top (OTT) Internet Protocol (IP)	7

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Note: As the efficiency across all base types has improved and Cable STB manufacturers are shipping models without CableCARD, EPA proposes to set a single base allowance for all STBs that connect to an MVPD network (Cable DTA, Cable, Satellite, and MVPD IP) and address any differences through functional adder allowances, addressed in the next section.

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The combination of base and adder allowances presented in Draft 1 allows a varied selection of products across the different base types and functionalities to qualify, including models with DVR, HNI (wired and wireless), and MR functionality.

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EPA has also removed the base allowance for Terrestrial STBs due to the lack of market availability of those products.

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EPA welcomes comment on this approach, including component-level data that would support any differences in the base allowances.

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3.3.3 Additional Functionality TEC Allowances (TEC_{ADDL_i}) shall be as specified in Table 3, subject to the following requirements:

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- i. No additional functionality allowances may be applied to STBs with CABLE DTA base functionality.
- ii. The HOME NETWORK INTERFACE and MIMO Wi-Fi HNI, UltraHD Resolution, and TC HEVP allowances are the only additional functionality allowances that may be applied to STBs with THIN CLIENT / REMOTE base functionality.
- iii. The CableCARD allowance may only be applied at most twice per STB or DVG.
- iv. The DOCSIS 3 allowances may only be applied to STBs or DVGs that are installed in a Service Provider network with DOCSIS capability.
- v. The MULTI-ROOM allowance may only be applied once per STB or DVG, regardless of the number of remote outputs served by the STB or DVG.
- vi. The MULTI-ROOM allowance may only be applied to STBs or DVGs that can provide live audio/video content to multiple devices (2 or more Clients) or support pause/time-shifting capability for otherwise standalone IP or Thin-client STBs.
- vii. The MULTI-ROOM allowance may not be combined with the HOME NETWORK INTERFACE allowance on a single STB or DVG.
- viii. The MIMO Wi-Fi HNI allowance can only be combined with HOME NETWORK INTERFACE or MULTI-ROOM allowance and only when the device is tested with Wi-Fi as the HOME

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- 358 NETWORK INTERFACE providing the primary video transport from the MULTI-ROOM STB
 359 or DVG to the device. It cannot be used at any other time and must be used in conjunction
 360 with the HOME NETWORK INTERFACE or MULTI-ROOM allowance.
- 361 ix. Either the ROUTER or ACCESS POINT allowance may be applied once per STB or DVG,
 362 and must be combined with the HOME NETWORK INTERFACE or MULTI-ROOM allowance.
- 363 x. The HEVP and TC HEVP allowances may only be applied to STBs that provide an UltraHD
 364 output through decoding an UltraHD stream or upscaling an HD stream per the Test Method.
 365 They may not be applied to DVGs.³

Note: EPA is proposing to revise the above rules for simplicity and to account to the changes to adders, below. Specifically, EPA has clarified that the CableCARD adder can be applied twice, consistent with the VA, and has removed instructions on applying the multi-stream and DOCSIS 2 allowance (set to 0 kWh in Table 3, below).

Table 3: Additional Functionality TEC Allowance (TEC_{ADDD_i})

Additional Functionality	Allowance (kWh/year)
Advanced Video Processing	0
Advanced Video Processing – Additional	0
CableCARD	15
CableCARD – Max One Additional	15
Digital Video Recorder (DVR)	45
DOCSIS [®] 2	0
DOCSIS [®] 3	11
HD	0
High Efficiency Video Processing (HEVP)	15
High Efficiency Video Processing for Thin Clients (HEVP-TC)	5
Home Network Interface (HNI)	17
MIMO Wi-Fi HNI: for each 2.4 GHz Spatial Stream	2
MIMO Wi-Fi HNI: for each 5 GHz Spatial Stream	5
Multi-room	35
Multi-stream – Cable/Satellite	0
Multi-stream –IP	0
Multi-stream – Additional	0
Transcoding	13
Transcoding – Each Additional	5
UltraHD Resolution	5

³ The HEVP allowances cover the decoding of HEVC video for display. Since DVGs are not tested with a local display, they are expected to rely on client STBs to perform decoding and therefore do not qualify for these allowances.

Additional Functionality	Allowance (kWh/year)
Access Point	5
Router	10
Telephony	4

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Note: EPA is proposing updated allowances for several additional functionalities due to continuing efficiency improvements. To determine the energy impact of each allowance, EPA constructed a dataset of 138 current models based on the ENERGY STAR certified product list, supplemented with models publicly reported by Service Providers under the VA. The energy contribution of each adder was then estimated through multivariate regressions, which compared the On Mode power and TEC of models with and without each adder.

EPA confirmed the robustness of these estimates by performing regressions across the entire dataset and individual base types, step-wise regressions with different combinations of adders (to identify those that were most likely to explain the variation in power of the models), and cross-correlation analyses of the adders themselves to identify adders that are typically used together. The last step prompted EPA to consolidate the allowance for Multi-stream with either DVR or MR, simplifying the table. Finally, EPA validated the results by discussing current and forthcoming functionality with industry stakeholders to ensure that it was not ignoring any features or trends. The results of the analysis are as follows:

AVP, HD: Provided for comparison with the VA, but no allowance proposed as AVP functionality necessary for receiving HD video is a standard feature, which should be accounted for by the base allowance.

CableCARD: Although Cable STB manufacturers can provide conditional access through software, without CableCARD and similar to other base types, most current Cable STBs continue to use it. EPA's regression analysis of VA data returned allowances ranging between 26 and 30 kWh/yr (both significant with <0.05 probability that the result occurred by chance), depending whether just the Cable or all STBs were analyzed. As the number of CableCARDS contained in the STBs claiming the adder is unknown, EPA is proposing the same allowance as in the VA: 15 kWh for the first CableCARD and 15 kWh for up to one additional CableCARD, for a potential total of 30 kWh. EPA also welcomes feedback on this proposal, typical energy consumption of CableCARD (separate from the base Cable STB functionality), and expected timing of deployment of models without CableCARD and the potential savings due to this transition.

DVR: EPA's regression analysis returned allowances ranging between 27 and 126 kWh/yr, many significant, depending whether ENERGY STAR or VA data were analyzed, and whether Cable, Satellite, or MVPD IP STBs were analyzed separately or jointly. EPA is proposing to retain the current allowance of 45 kWh, which is close to the average of the DVR estimates and aligns with the VA.

DOCSIS: Regression analysis did not result any significant estimates for the DOCSIS 2 allowance, so EPA is proposing to reduce the DOCSIS 2 allowance to zero, to recognize the leadership of transitioning to the higher performance and expected lower power DOCSIS 3 standard (which supports a low-power 1x1 mode). To this end, EPA is proposing to continue the 11 kWh allowance for DOCSIS 3, included in the Version 4.1 specification. EPA welcomes feedback on the DOCSIS 2 to DOCSIS 3 transition, as well as whether the proposed DOCSIS 3 and CableCARD adders fully account for Cable STBs' need to directly communicate with the head-end (in contrast to IP and Satellite which use additional equipment in the form of low-noise block (LNBS) downconverters and optical network terminals (ONTs), respectively).

HEVP, HEVP-TC, and UHD: EPA is not proposing any changes to the allowances for these new functions due to their currently limited penetration in the market, but has rearranged the name of the thin-client HEVP adder to allow it to be alphabetized with HEVP.

420
421 **HNI:** EPA's regression analysis returned allowances ranging between 5 and 36 kWh/yr, depending on the
422 subset of STBs analyzed, with estimates of 20 and 36 kWh considered significant (<0.05 probability that
423 the result occurred by chance). Since these results are similar to the allowances currently provided under
424 Version 4.1, EPA is not proposing any changes and maintaining a single technology-neutral HNI
425 allowance, with the MIMO HNI adder recognizing the additional flexibility provided by wireless technology.
426

427 **MIMO HNI:** Regression estimates for MIMO Wi-Fi HNI were 27 kWh for 2.4 GHz and 22 for 5 GHz
428 (unknown number of spatial streams). These results were not considered significant partly due to the
429 limited number of STBs currently supporting MIMO. Based on the energy consumption of recently tested
430 small networking equipment (routers and access devices), EPA is proposing to reduce the MIMO
431 allowance to 2 kWh/yr per 2.4 GHz stream and 5 kWh/yr per 5 GHz stream.
432

433 **Multi-room:** EPA's regression analysis returned allowances ranging between 3 and 56 kWh/yr, again
434 depending on the subset of STBs analyzed, with estimates of 22, 26, 32 and 56 kWh considered
435 significant (<0.05 probability that the result occurred by chance). EPA is proposing a revised allowance of
436 35 kWh which is approximately the average of those values.
437

438 **Multi-stream:** Due to the overlap between Multi-stream and other functions (DVR, HNI, MR), EPA is
439 proposing to consolidate. The adder was removed from the regression analysis and any additional
440 allowance was distributed among the remaining adders. Although EPA understands that there are some
441 cases where STBs support Multi-stream without DVR or Multi-room (e.g., for picture-in-picture capability),
442 there is a limited number of set-top boxes in this situation and the advent of full-band tuners should permit
443 tuning multiple channels without the energy overhead. EPA welcomes feedback on this proposal.
444

445 **Transcoding:** EPA's regression analysis returned allowances ranging between 24 and 30 kWh/yr,
446 depending on the subset of STBs analyzed, with the 30 kWh estimate considered significant (<0.05
447 probability that the result occurred by chance). It is unclear how many transcoding streams were used
448 during the test for the VA models claiming this allowance (all Cable Multi-room DVRs); however, if several
449 streams are used, then the VA's allowance of 13 kWh for the capability with 5 kWh for each additional
450 stream would appear appropriate. EPA welcomes feedback on this proposal.
451

452 **Access Point, Router, Telephony:** No STBs in the dataset supported these features. Nonetheless, EPA
453 is continuing to expect gateway STBs with this functionality to emerge. Based on recent EPA tests of
454 commercially available routers and access points, EPA is proposing to reduce the allowances to 5 kWh/yr
455 for Access Point and 10 kWh for Router. As noted, a product cannot claim both the Router and Access
456 Point allowance. No change is proposed for Telephony.
457

458 EPA has also added placeholders for the following adders even though it is not providing allowances, to
459 ease comparison with the VA:

- 460 • Advanced Video Processing
- 461 • Advanced Video Processing – Additional
- 462 • HD
- 463 • Multi-stream – Additional

464
465 Finally, EPA has alphabetized the adders for easier reference, with the exception of the networking
466 adders, which are grouped together.

467 3.3.4 **Client Only Incentive:** Multi-room STBs can receive an incentive for use in Equation 1 by going
468 into a lower-power state while continuing to provide video to their connected clients, as calculated
469 in Equation 4. Note, because DVGs lack a connected Display Device, they always operate in
470 Client Only mode (measured in the Test Method). Therefore, this incentive applies only to STBs
471 and not DVGs.

472

473

Equation 4: Calculation of Client Only Incentive for Multi-room STBs

$$Incentive_{CLIENT_ONLY} = \frac{P_{WATCH_TV} - P_{CLIENT_ONLY}}{P_{WATCH_TV}},$$

474

Where:

475

- $Incentive_{CLIENT_ONLY}$ is the Client Only Incentive applicable to Multi-room STBs;

476

477

- P_{WATCH_TV} is the measured power in On Mode (W) for Multi-room STBs; and

478

- P_{CLIENT_ONLY} is the Sleep Mode Power as measured in the Test Method.

479

480

Note: Products intended for sale in the US market are subject to minimum toxicity requirements. Please see ENERGY STAR® Program Requirements for Set-top Boxes: Partner Commitments for details.

481

482

483 4 TESTING

484 4.1 Test Methods

485 4.1.1 Test methods identified in Table 4 shall be used to determine energy consumption.

486 **Table 4: Test Methods for ENERGY STAR Qualification and Additional Incentives**

Product Type	Test Method
STBs and Displayless Video Gateways (DVGs)	TBD

487

488 **Note:** The U.S. Department of Energy (DOE) and EPA are revisiting the test method, which will
 489 be released as part of a separate announcement, shortly. The test requirements which were
 490 previously part of Section 4, Testing, will now be part of the revised test method.

491 4.2 Certification Options

492 4.2.1 ENERGY STAR requirements must be met under worst case testing in terms of all hardware and
 493 software configurations and under all potential MVPD networks/operating scenarios applicable to
 494 the model during operation. ENERGY STAR manufacturer/brand owner Partner must report the
 495 most consumptive results for the model. The reported value may exceed the tested value.

496 4.2.2 If a Partner wishes to certify configurations of a model for which non-ENERGY STAR certified
 497 alternative configurations or operating scenarios exist, the Partner must assign the certified
 498 configurations an identifier in the model name/number that is unique to ENERGY STAR certified
 499 configurations. This identifier must be used consistently in association with the certified
 500 configurations in marketing/sales materials and on the ENERGY STAR list of certified products
 501 (e.g. model A1234 for baseline configurations and A1234-ES for ENERGY STAR certified
 502 configurations).

503 **Note:** EPA considered aligning certification testing with that of the VA such that products must be tested
 504 on the MVPD network on which it would be used. However, EPA determined that doing so would penalize
 505 smaller providers and thus has maintained the above approach.

506 **5 USER INTERFACE**

507 5.1.1 Partners are encouraged to design products in accordance with the user interface standard IEEE
508 P1621: Standard for User Interface Elements in Power Control of Electronic Devices Employed in
509 Office/Consumer Environments. For details, see <http://eetd.LBL.gov/Controls>.

510 **6 EFFECTIVE DATE**

511 6.1.1 Effective Date: The Version 5.0 ENERGY STAR Set-top Box specification shall take effect on
512 **January XX, 2017**. To qualify for ENERGY STAR, a product model shall meet the ENERGY
513 STAR specification in effect on its date of manufacture. The date of manufacture is specific to
514 each unit and is the date on which a unit is considered to be completely assembled.

515 6.1.2 Future Specification Revisions: EPA reserves the right to change this specification should
516 technological and/or market changes affect its usefulness to consumers, industry, or the
517 environment. In keeping with current policy, revisions to the specification are arrived at through
518 stakeholder discussions. In the event of a specification revision, please note that the ENERGY
519 STAR qualification is not automatically granted for the life of a product model.